The Structuring of Design Knowledge

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In this chapter, we draw on a cutting-edge sociological approach to describe the structuring of design knowledge. Two concepts from Legitimation Code Theory, *specialization codes* and *semantic gravity*, are used to explore the nature of competing claims to legitimacy and context-dependency of meanings in design knowledge. We argue that a focus on the structuring of design knowledge that explicitly articulates its organizing principles helps clarify the acquisition and enactment of design practices and processes of cumulative knowledge-building in design.

INTRODUCTION

Design knowledge - comprising theories, practices, principles, cases, guidelines, patterns, and cognitive strategies - influences more than design praxis. Design knowledge has been applied to business strategy (Brown, 2008, Verganti, 2009, Martin, 2009), technological innovation (Hobday et al., 2011, Hobday et al., 2012), management theory (Boland and Collopy, 2004), educational curriculum (Kolodner et al., 2003), and human development policy (Oosterlaken, 2009), to name but a few. Indeed, many management scholars could explain the concept of 'design thinking' without needing to appreciate its origins in architectural design (Rowe, 1987). A plurality of descriptions of and claims to design knowledge underlies this reach into new fields as 'design and design thinking continue to expand their meanings' (Buchanan, 1992, p. 8). Design has thus successfully expanded into a host of domains. However, this expansionist plurality comes at a cost. Often understandings of design knowledge remain locked within the specificities of the practices under consideration – they reflect whatever is being looked at. The result is a segmented understanding of what constitutes 'design knowledge'. This segmentation is reinforced by a tendency to focus on empirical descriptions of the *content* of design knowledge rather than the organizing principles underlying design knowledge regardless of the substantive content. Moreover, this focus on its surface features is also found in attempts to integrate understandings of design knowledge into a coherent theory (Love, 2002, Manzini, 2009, Franz, 1994). The combined result of expansion, plurality and a focus on content is that the field of design risks fragmentation of its knowledge (Galle,

2008) and a lack of agreement on even the most basic of its terms (Poggenpohl et al., 2004).

The perspective we illustrate here suggests that exploring the structuring of design knowledge aids understanding its diverse forms and that these forms shape design knowledge in all manner of ways, including its social accessibility, empirical adequacy, potential for cumulative development and explanatory power. Rather than developing a general, unified canon of design knowledge or criteria for this canon, we aim to help explore competing claims to design knowledge in terms of their organizing principles. To bring these principles into view we shall introduce concepts from a framework for the analysis of knowledge practices and their effects: Legitimation Code Theory (LCT). Specifically, we shall explore two organizing principles underlying the ways scholars have presented criteria for design knowledge. First, we focus on *specialization codes* or the ways the legitimacy of knowledge and knowers in design – its methods and techniques and those said to possess them – are articulated in debates over design knowledge. Second, we explore differences in *semantic gravity* or the context-dependence of legitimate design knowledge, focusing on two dominant and contrastive research approaches. Different settings of these organizing principles, or *legitimation codes*, represent different understandings of design knowledge. We discuss problems raised by competing claims to legitimacy, or *code clashes*, and the importance of avoiding the field's fragmentation by making transparent what code is emphasized by which actors, when and for what practices. To conclude we highlight the significance of understanding the structuring of design knowledge and discuss the effects of these organizing principles on knowledge practices associated with design.

TOWARDS PRINCIPLES OF DESIGN KNOWLEDGE

The promise of design as a core competency beyond task-level technical proficiency makes design studies an exciting field of research. Within this field, design knowledge tends to be viewed diversely, as comprising: a set of practical skills, such as sketching and modelling; cognitive strategies, such as framing (Dorst, 2011) and analogical reasoning (Visser, 1996); and individual or group dispositions, such as

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curiosity (Beverland and Farrelly, 2007), deep cultural interests (Strickfaden et al., 2006), and cross-disciplinarity (Adams et al., 2011).

While diversity can be a strength, the plurality of claims to create design knowledge from various disciplines can also introduce segmentation among knowledges that are context-dependent. Design scholars have recurrently attempted to bring coherence to these positions through theories of design (e.g., Hatchuel and Weil, 2009), unifications of paradigms of design (Dorst, 2008, Dorst and Dijkhuis, 1995), and specifications of criteria for unifying theories (Friedman, 2003, Love, 2002). Owen's 'map of disciplines' (Owen, 1998) re-frames the question from 'what is design research?' to 'how is knowledge built?' and distinguished disciplines in terms of two dichotomies: 'analytic' or 'synthetic'; and 'symbolic' or 'real'. 'Analytic' disciplines focus on discovery, whereas 'synthetic' disciplines emphasize making; 'symbolic' disciplines interact with abstract phenomenon, whereas 'real' disciplines engage with physical artefacts. Owen then described alternative modes of knowledge production associated with these four types. Against a single design research method, he argued that modes of design research should be based upon the extent to which the inquiry is targeted toward establishing new or mastering existing theory and methods.

Models such as Owen's offer a valuable first step: they bring the nature of design knowledge into view. However, they also need theoretical development. As researchers attempting to enact such models experience, they struggle to capture empirical practices, which rarely fit within their lists of types, or processes of change within and between types. This invariably leads to the creation of further typologies with more or different types and sub-types of knowledge or to new demarcation criteria. However, the problem is not the comprehensiveness of categories but the form of the models themselves: their typological form limits their practical usefulness. To explore the nature of design knowledge we thus need to conceptualize the organizing principles that generate diverse types of knowledge practices in design.

LEGITIMATION CODE THEORY

Legitimation Code Theory (LCT) offers a multi-dimensional conceptual framework for analysing the organizing principles of knowledge practices (Maton, 2014). LCT is

a central framework within the 'school of thought' of social realism, which shows knowledge to be not only socially constructed but also real in the sense of possessing properties and powers that have effects. Accordingly, social realist research explores the organizing principles of different forms of knowledge, their modes of change, and their implications for such issues as social inclusion, student achievement, and knowledge-building (e.g. (Maton and Moore, 2010)). LCT extends and integrates ideas from a range of theories, most centrally the sociological frameworks of Pierre Bourdieu and Basil Bernstein (Maton, 2014). Over the past decade the framework has grown rapidly as a basis for empirical research into education at all institutional levels and across the disciplinary map – from universities to primary schools, from jazz to physics – in a widening range of national contexts, as well as beyond education, including museums, armed forces and parliaments (e.g. (Maton et al., 2014)).[i] This includes a small but growing body of work exploring design (Carvalho et al., 2009, Shay and Steyn, 2014). LCT is being enacted at various levels of analysis, from single passages of text to national education systems, and using both qualitative and quantitative research methods (Maton et al., 2014). It thus allows studies of diverse practices and contexts, using diverse methods, to build on one another.

LCT comprises a multi-dimensional conceptual toolkit, where each dimension offers concepts for analysing a set of organizing principles underlying practices as *legitimation codes* that propose differing ways of viewing legitimacy within the field. There are currently five dimensions to LCT, each centred on conceptualizing a different form of legitimation code (Maton, 2014). In this paper we shall draw on concepts from two dimensions: from Specialization we shall employ *specialization codes*; and from Semantics we adopt *semantic gravity*.

Specialization of design knowledge

To introduce the notion of *specialization codes,* consider Edmund Happold's argument about what the professions of engineering and architecture bring to design:

> An engineer's training is classical; it is a training in control. An architect's training is primarily romantic, a training in aesthetic conscience. This is not to say that no architect can reason or that all engineers are unromantic. Yet people certainly tend to think in one

mode or the other, and to misunderstand what the other mode is about.
They see conflict between the two modes and control by their own
mode as essential.

<div align="right">(Happold, 1986, p. 136)</div>

Here Happold is describing very different bases of achievement: one where legitimacy is based on a shaping of the knower's gaze (architect); the other where legitimacy follows the acquisition of specialist knowledge (engineering). The organizing principles underlying these competing ideas of what it means to be good at design can be understood in terms of *specialization codes* (Maton, 2014). These concepts begin from the simple premise that every practice, belief or knowledge claim is about or oriented toward something and is made by someone. They thus involve relations to objects and to subjects. One can thus analytically distinguish: *epistemic relations* (ER) between knowledge and its proclaimed objects of study (that part of the world towards which they are oriented); and *social relations* (SR) between knowledge and its authors or subjects (who is enacting the practices). Each relation may be more strongly (+) or weakly (–) emphasized in practices and beliefs and these two relative strengths of emphasis together give the 'specialization code'. Thus, a claim to knowledge may be viewed as legitimized by its epistemic relations, by its social relations, by both, or by neither. Figure 1 outlines four principal codes:

- *knowledge codes* (ER+, SR–), where possession of specialized knowledge, skills or procedures are emphasized as the basis of achievement, and the dispositions of actors are downplayed;
- *knower codes* (ER–, SR+), where specialist knowledge or skills is less significant and instead the dispositions of actors are emphasized as measures of achievement, whether viewed as natural (e.g. 'genius'), cultivated (e.g. artistic gaze) or socially based (e.g. feminist architecture);
- *elite codes* (ER+, SR+), where legitimacy is based on both possessing specialist knowledge and being the right kind of knower ('elite' does not necessarily mean 'socially exclusive' but rather the necessity of possessing *both* legitimate knowledge *and* legitimate dispositions); and
- *relativist codes* (ER–, SR–), where legitimate insight is neither determined by specialist knowledge nor knower attributes.
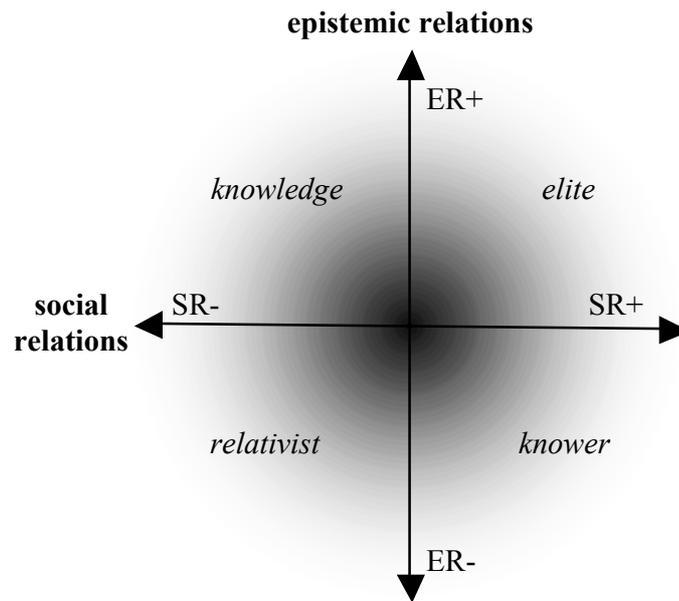
Figure 1. Specialization codes (Maton 2014: 29).

Returning to our example, for Happold engineers embody a knowledge code, architects embody a knower code, and they therefore experience what LCT terms a 'code clash' (Maton, 2014) between competing principles of legitimacy.

The notion of specialization codes thereby provides a way to understand competing constructions of legitimate knowledge and knowers within the field of design. For example, a major study explored how designers perceive legitimacy within their field (Carvalho et al., 2009). Interviews (N=10) and an online survey (N=139) were conducted in four design-related disciplines: architecture, engineering, digital media, and fashion. Results revealed that bases of achievement: in engineering emphasized specialist knowledge, procedures and methods (knowledge code); in fashion emphasized designers' dispositions (knower code); and in architecture emphasized both specialist knowledge and specialized attributes of knowers (elite code). (Digital media combined knowledge codes and knower codes, depending on the respondent). We should emphasize that strengths of epistemic relations and social relations (and thus specialization codes) are relative; put another way: there are always knowledges and always knowers. The difference is emphasis in legitimacy (Maton, 2014). Thus, this is not to suggest engineers have no engineering 'gaze' or fashion designers lack technical skills. Moreover, 'dominant codes may not be transparent, universal or

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uncontested: not everyone may recognize and/or be able to realize what is required and there may be more than one code present, with struggles over which is 'dominant'' (Maton, 2014, p. 77). In short, specialization codes offer insight into the forms taken by knowledge practices without suggesting they are immutable or essential, and highlight the ways in which these become subject to 'code clashes' between fundamentally contrasting views of legitimacy.

Crucially, the forms taken by knowledge practices have effects. For example, when knower codes dominate a context, individuals may face challenges in becoming the 'right' kind of knower (Maton, 2004, Maton, 2006). Design education often acculturates students in institutionally-based cultures into a specific kind of knower with a particular set of tastes. Wilson (1996) studied the socialization of cultural awareness in relation to the evaluation of architecture in 150 British students selected across all years of education from two schools of architecture. Socialization within a school oriented the students toward particular styles of architecture, depending upon the school into which they were enrolled. In other words, architectural education was producing a certain type of knower with a set of sensibilities specific to a school of architecture. As studies using LCT demonstrate (e.g. (Chen et al., 2011)), this can be problematic for those whose pre-existing sensibilities do not match the required dispositions, especially if what is required is not made explicit. Moreover, where different codes come into contact, such as in multidisciplinary research teams or faculties, there is the possibility for 'code clashes' among actors whose bases for achievement are fundamentally different (Carvalho *et al.* 2009).

Semantic gravity: Context-dependency and design knowledge
To introduce the second concept we wish to highlight, *semantic gravity*, consider two positions on design knowledge. Boling and Smith, scholars of visual design and interior design, respectively, argue that design knowledge should be communicated as 'transparently as possible from the perspective in place at the time' rather than 'as abstractions, such as principles or models' (Boling and Smith, 2012, p. 52). In contrast, Höök and Löwgren, human-computer interaction designers, propose design knowledge as 'strong concepts' that are 'cutting across particular use situations' and 'resides on an abstraction level above particular instances' (Höök and Löwgren, 2012, p. 1). While both highlight context-dependence as significant, the former view

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legitimacy as flowing from the concrete, context-specific nature of design knowledge, and the latter view legitimacy as based on its freely-floating and abstracted nature. Both, however, share a sense that the issue is a choice between concrete and abstract forms of knowledge. The concept of *semantic gravity* offers a means of analysing these contrasting positions and overcoming this false dichotomy:

> *Semantic gravity* (SG) refers to the degree to which meaning relates to its context. Semantic gravity may be relatively stronger (+) or weaker (−) along a continuum of strengths. The stronger the semantic gravity (SG+), the more meaning is dependent on its context; the weaker the semantic gravity (SG−), the less dependent meaning is on its context. … Semantic gravity thus traces a continuum of strengths with infinite capacity for gradation. Moreover, by dynamizing this continuum to analyze change over time, one can also describe processes of: weakening semantic gravity (SG↓), such as moving from the concrete particulars of a specific case towards generalizations and abstractions whose meanings are less dependent on that context; and strengthening semantic gravity (SG↑), such as moving from abstract or generalized ideas towards concrete and delimited cases.
>
> (Maton, 2013, p. 11).

The forms taken by strengths of semantic gravity depends on the specificities of the object of study. Table 1 adapts Maton (2009) to illustrate strengths of semantic gravity with forms of design knowledge.

Table 1 Examples of strengths of semantic gravity of design knowledge

Semantic gravity	Form	Description	Example
weaker ↑ ↓ stronger	Abstraction	Presents a general principle applicable to wider or future design practice	Design principles (e.g., the 10 Principles of Good Design by Dieter Rams)
	Generalization	Presents a general observation or draws a generalizing conclusion about issues and events *in the case*	Design pattern
	Review	Goes beyond the context and offers a value judgment or claim based on new information or personal experience	Design review (e.g., architectural criticism)
	Summarizing description	Summarizes information directly from the context	Design case
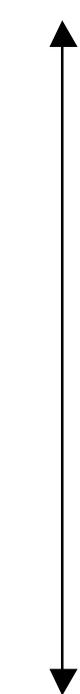
Using this concept, the arguments of Boling and Smith (2012) and Höök and Löwgren (2012) can be redescribed as advocating knowledge with stronger and weaker semantic gravity, respectively. LCT also highlights that these strengths may be appropriate for different purposes, disciplines, social groups, etc. – i.e., no single strength is the key to legitimacy. They thus represent endpoints on a far greater range of possible practices rather than a forced choice between two positions.

Matches and clashes between such contrasting strengths of semantic gravity helps explain how knowledge claims are viewed by actors within a discipline. For example, Christopher Alexander's pattern language for architecture (Alexander et al., 1977) is notable for its welcome application by other disciplines, such as computer science (Manolescu et al., 2006) and education (Goodyear, 2005), but opposition within architecture itself (Dovey, 1990). As Dovey relates, the 'enemies' of Alexander's pattern language offer diverse criticisms but share an opposition to its 'dependence on the "one right way" of designing' (Dovey, 1990, p. 7). In other words, the strength of

semantic gravity characterizing Alexander's design pattern language is deemed too weak; postmodern architecture theory, for example, eschewed universalism with a commitment to the development of knowledge about architecture by reading meaning from specific cases – buildings.

As well as conceptualizing the basis of such clashes, 'semantic gravity' also enables the analysis of change over time. For example, organisers of the Design Thinking Research Symposium 7 (The Design Meetings Protocols) stated: 'For the seventh workshop we wanted to concentrate on *naturally occurring design activity in the authentic setting of design practice*, allowing a more complicated and contextual view of the design process to emerge, a trend in design research that has gathered pace in recent years.' (Lloyd and McDonnell, 2009, p. 115). They advocate and describe a shift within the design studies research community towards preferring design knowledge acquired closer to the context of practice. This represents an explicit shift toward strengthening semantic gravity, one also evident in a recent Special Issue of *Design Studies* about the study of design as it is practiced using ethnomethodology and conversation analysis. The Guest Editor Rachael Luck wrote that the papers (emphasis added) 'explore the *distinctiveness of design situations* and as such are *not directed towards generalisation*, although, as we shall see, they can be considered generative in nature.' (Luck, 2012, p. 521)

This move toward acquiring design knowledge closer to its context of acquisition (in practice) rather than laboratory settings of brief, fixed duration, and away from the generalization of design cases toward 'rigorous praxeological accounts of (design) practice' (Luck, 2012, p. 523) contrasts with the weaker semantic gravity exhibited by the cognitive design research paradigm (Visser, 2006, Visser, 2009). Proponents view design as 'fundamentally mental, representational, and a signature of human intelligence: Features that surely make it an important subject of study in cognitive science.' (Goel and Pirolli, 1992, p. 395-396). Cognitive design research, and its related research methods, produces generic schemas (Gero, 1990) and descriptions of thinking processes associated with design. Criticisms of this cognitive view of design activity are long-standing and have varied in their focus and theoretical origins (Lloyd, 2003). Nonetheless, in addition to any specific substantive differences of which theory is advocated, what methods chosen, and so on, these approaches

fundamentally differ at the deeper level of their organizing principles, specifically their relative strengths of semantic gravity.

LCT AND IMPLICATIONS FOR DESIGN RESEARCH

Having introduced two concepts from LCT to explore the organizing principles of design knowledge, we turn to the question of the effects of the forms of knowledge on practices and cumulative knowledge building in design. Design scholars have addressed and re-addressed the question whether design research has any value, and, if so, what methods of research should be adopted in establishing the design canon (Cross, 1999, Friedman, 2003, Love, 2002). We believe it is more productive to start from the basis that different forms of design knowledge have different affordances (Maton, 2009). In other words, knowledge has perceptible qualities upon which users base their actions (Gibson, 1979). From hereon in, when we mean design knowledge, we refer to the content and form of knowledge, i.e., tools and methods (ER+), schools of design (SR+), design cases (stronger semantic gravity), design principles (weaker semantic gravity) and so on. When one applies design knowledge in a specific context, the form of the knowledge matters.

The acquisition of knowledges tracing a range from stronger to weaker semantic gravity is necessary for design practice and for practitioners to build upon prior knowledge for future design practices (cf. Dym et al., 2005). Cumulative learning (building domain expertise) involves the simultaneous acquisition of both abstract design principles and their use in a specific context. This is the type of transition designers undertake in the progression from novice to master (Lawson and Dorst, 2009). To do so requires forms of knowledge that support progressing from specific design cases to abstract design principles and vice versa. In other words, this progression requires 'gravity waves' – recurrent weakening and strengthening semantic gravity – that grow bigger over time as they reach upwards from concrete instances to greater levels of generalization and abstraction (Maton, 2013, Maton, 2014).

Research by Ball *et al*. (2004) compared the analogical reasoning capabilities of novice masters-level engineering students and professional practicing engineers. Their

task entailed the design of an automated car rental facility. The researchers coded the concurrent verbalizations of the designers in relation to spontaneous analogical reasoning, that is, the manner by which the participants referred without prompting to prior design cases and applied knowledge from those cases to the design task. They found that whereas the novice designers referred to specific characteristics of prior design cases (stronger semantic gravity) that could be applied immediately to experimental design task, the expert engineers applied abstract, experiential knowledge (weaker semantic gravity) obtained from prior design cases. Examples of design principles relevant to the experimental task included principles associated with the design of outdoor terminal displays; in contrast, examples of concrete cases associated with the design task included specific screen designs at other venues that could be applied at the car rental facility. Ball *et al*. (2004) conclude that progressing from novice to expert requires design students to acquire skills to rely less on concrete episodes and more on design principles. This is not exclusive to design. Studies using LCT to explore not only design (Shay and Steyn, 2014) but fields as diverse as biology, history (Maton, 2014), English (Maton, 2009) and physics (Georgiou, 2014) are highlighting the significance of differences in such organizing principles of knowledge practices as *semantic gravity* to changing notions of achievement through apprenticeship.

Weakening the semantic gravity of previously acquired knowledge to move beyond the specificities of a case is a key strategy for then strengthening semantic gravity by applying that knowledge. Research in design fixation confirm that it is essential to abstract relations among source cases before applying them to the current design context (Goldschmidt, 2011). Research by Zahner *et al*. (2010) demonstrates a positive effect of abstract design knowledge (weaker semantic gravity) on de-fixation under two situations: by providing abstract formulations of design problems as case stimuli and by asking designers to produce generalizations of specific design cases presented as stimuli before applying them to the design task. Design tools assisting in the process of abstracting case data to higher levels of generalization similarly reduce fixation effects (Linsey et al., 2012). This evidence suggests that design knowledge having weaker and stronger semantic gravity can mutually reinforce and support each other. The surface features of design cases prime the recognition and retrieval of schematic knowledge (Klein, 1993). Knowledge embracing a range of strengths of

semantic gravity is thus necessary for design practice and for the field to build upon knowledge for future design practices (cf. Dym et al., 2005).

The point of these examples is to demonstrate that it is not simply the content of knowledge but also its underlying structure or organizing principles that affect knowledge practices in design. Having access only to knowledge characterized by overly strong semantic gravity may be too specific to apply to other cases, producing design fixation. Likewise, having access to knowledge characterized by overly weak semantic gravity may not have sufficient detail to realise solutions for the current design context. Using this concept, our response to the debate between design cases (Boling and Smith, 2012) and 'strong concepts' (Höök and Löwgren, 2012) is that this offers a false dichotomy: both forms of knowledge are required to enable the selection and recontextualization of research - or practice-based design knowledge. In summary, the recontextualization of knowledge, an essential attribute of knowledge-building over time (Maton, 2013), requires the weakening of semantic gravity from specific cases and meanings to general principles. Moreover, changes in semantic gravity of knowledge are also evident in the processes of recontextualization whereby 'design thinking' has come to be applied within disciplines outside design. This recontextualization depends upon, inter alia, the encapsulation of core concepts (weaker semantic gravity) about reasoning in design (Beckman and Barry, 2007).

The false dichotomy between design cases and 'strong concepts' is also shown by the ways design researchers and practitioners exploit a range of strengths of semantic gravity in design knowledge, from abstract, generalized principles and complex meanings to concrete and specific practical applications. In routine design tasks, with well-defined and specific problems, it may be more efficient to apply context-dependent meanings from prior problems: design knowledge would here exhibit relatively strong semantic gravity, such as a specific rule or code-driven design method for steel structures. In contrast, for design-driven innovation, designing from first principles (Cross and Cross, 1996) may be more likely to lead to breakthroughs, foregrounding the value of design knowledge of relatively weak semantic gravity. In further contrast to these states, other practices require strengthening and weakening semantic gravity. For example, when designers search for and develop new, creative solutions to known, stable problems, they need to overcome design fixation and may

engage in design by analogy. Analogical stimuli of problems 'far' from the domain of the design situation (the problem and analogical problem share few features) can lead to more creative solutions (Fu et al., 2013) and avoid design fixation (Tseng et al., 2008). The ability for designers to weaken semantic gravity to search for creative ideas far from the problem situation and then strengthen semantic gravity by bringing those ideas to bear upon the specific problem in collaborative design situations is also linked to more creative outcomes (Dong, 2006). In short, as these illustrative examples highlight, no single state or form of knowledge is the key to successful design practice, and analysing the diverse forms taken by design knowledge requires conceptualizing its organizing principles.

CONCLUSION

In this chapter, we have briefly explored how the organizing principles underlying design knowledge have real effects on the manner by which design research is performed, the form that design knowledge takes, and knowledge practices. We highlight how debates within the field about legitimate design knowledge, produced through various research methods and research contexts, could be explored using the concepts of specialization codes and semantic gravity from Legitimation Code Theory. Using these concepts, we describe the specialization codes dominating certain disciplines of design and the debates within the design research community over the form that design knowledge should take. We analysed the way in which design knowledge that embraces a wide range from stronger to weaker semantic gravity is crucial to design practice. In short, we have pointed to real effects of the forms of design knowledge, in the way individuals in the field perform research, legitimate knowledge, and practice design.

Organizing principles underlying knowledge practices do not remain static; rather, the 'settings' of principles such as semantic gravity reflect ongoing debates within fields regarding the bases of achievement within them. As these settings change, so too may educational curriculum, as evidenced by changes to architectural education curriculum, as the field moved away from the design methods movement and modernism (away from ER+) (Robbins, 1984, Ward, 1989). Thus the issues reach from design practice to design education.

No doubt, debates over the 'right' form of design knowledge will continue. As we discussed, the organizing principles underlying design knowledge have implications beyond design practice. While this chapter focused on intellectual implications, anxiety over the viability of design as a legitimate research discipline in universities worthy of doctoral level training (Pedgley and Wormald, 2007, Margolin, 2010) is a pressing and practical concern. Defining the distinctive strengths and contributions of the various forms of design knowledge and defending the settings of organizing principles underlying them will be essential for design research to compete among other fields for a place in approaches to knowledge production.

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[i] For examples of this rapidly growing body of work, see the LCT website:

http://www.legitimationcodetheory.com